CLAIMS

1. Multi-user detection method with elimination of interference between users, each user transmitting modulated data in the form of symbols on a transmission channel, each transmission channel (k) comprising at least one propagation path (p) and each propagation path arriving at an array of reception antennae (ℓ) in a direction of arrival $\theta_{p,k}$, the method comprising at least one sequence of steps for each user, characterised in that each sequence comprises:

(a) a step of estimating the signal transmitted (500_k,600_k,700_k,800_k,900_k,900,1000) by the user from the antennae signals, the said step effecting an estimation (530_p) of the direction of arrival ($\theta_{p,k}$) and characteristics ($\alpha_{p,k}$, $\nu_{p,k}$) of propagation of each path (p) of the transmission channel (k) from the said signals;

(b) a step of estimating the data transmitted (610_k,710_k,810_k,910_k,910,1010) by the user from the said estimation of the signal transmitted;

(c) a step of estimating the contribution (670_k,770_k,870_k,970_k,970,1070) of the user to the signals received by the different antennae from the data estimated at step (b) and the direction of arrival as well as the propagation characteristics estimated at step (a);

(d) an interference elimination step ($680_{k'}$,780_k,$880_{k'}$,$980_{k'}$,980,1080) subtracting from the antennae signals the contribution estimated at step (c) in order to obtain cleaned antennae signals; the cleaned antennae signals supplied by at least a first sequence being used as antennae signals by at least a second sequence.

2. Multi-user detection method according to Claim 1, characterised in that, for a given user k, the interference is eliminated by subtracting (680_k,880_k) from the antennae signals the contributions of all the other users.

3. Multi-user detection method according to Claim 1, characterised in that the users are classified by order of power received and the interference is eliminated by subtracting (780_k) one after the other the contributions of the different users commencing with the users with the highest powers received.

4. Multi-user detection method according to one of the preceding claims, characterised in that, for each user k, the said sequence comprises, after the step of estimating the said data (610_k,710_k,810_k,910_k,910,1010), a deinterleaving step (620_k,720_k,820_k,920_k,920,1020) followed by a channel decoding step (630_k,730_k,830_k,930_k,930,1030), a channel coding step (640_k,740_k,840_k,940_k,940,1040) and a step (650_k,750_k,850_k,950_k,950,1050) of interleaving the said data.

5. Multi-user detection method according to one of the preceding claims, characterised in that, for each user k, the said sequence comprises, prior to the step of estimating the contribution (670_k,770_k,870_k,970_k,970,1070) of the user to the received signals, a step of modulation and spectral respreading (660_k,760_k,860_k,960_k,960,1060) by means of the signal which was used to spectrally spread the symbols of the said user.

6. Multi-user detection method according to one of the preceding claims, characterised in that, the estimations of the transmitted signals of the users being considered to be an estimations vector with K components where K is the number of users, the said vector is subjected to a transverse matrix filtering (905,1005) before the decision step (910,1010).

7. Multi-user detection method according to Claim 6, characterised in that, the estimated and remodulated data of the users being considered to be a vector of symbols with K components, the said symbols vector is subjected to a postcursor

matrix filtering (1007) and the output of this filtering is subtracted, vector by vector, from the output of the transverse matrix filtering (1005).

8. Multi-user detection method according to Claims 4, 5 and 6, characterised in that, the symbols issuing from the modulation step (1061) being considered to be a symbols vector with K components, the said symbols vector is subjected to a postcursor matrix filtering (1007) and the output of this filtering is subtracted, vector by vector, from the output of the transverse matrix filtering (1005).

9. Multi-user detection method according to Claims 2 and 4, characterised in that the estimations of the signals transmitted by the different users are subjected to a matrix multiplication (805) by a matrix $(F^T)^{-1}$ before the data estimation step, where F^T is the transpose of the lower triangular matrix F obtained by Cholesky decomposition of the signature correlation matrix which was used to spectrally spread the symbols of the said users, the interference being eliminated, for a given user k, in a first phase, by subtracting ($807_{k',k}$) from the k^{th} component of the matrix product the sum $\sum_{i=1}^{k-1} A_i.F_{k,i}.\hat{s}_i$ where A_i is the amplitude of the signal transmitted by the user i, $\hat{s}_i$ is the symbol obtained by remodulation (861_k) of the estimated data of the user i and $F_{k,i}$ the (k,i)th element of the matrix F, the estimation of the data transmitted by the user k being effected from the k^{th} component after the said subtraction and, in a second phase, by subtracting (880_k), from the signals received by the different antennae, the sum of the contributions of all the other users.

10. Multi-user detection method according to one of the preceding claims, characterised in that, for each user k, the step of estimating the signal transmitted by the user, on the transmission channel (k), comprises a formation of channels (520_1,..,520_F) in the directions of arrival of the different propagation paths (p) of the said channel.

11. Multi-user detection method according to Claim 10, characterised in that the channel formation (520_p) for a propagation path of a transmission channel can place zeros in the directions of arrival of the other propagation paths of the same transmission channel.

12. Multi-user detection method according to Claim 11, characterised in that the channel formation ($520_{p,k}$) for a propagation path (p) of a transmission channel (k) can also place zeros in the directions of arrival of all the propagations paths of the other transmission channels.

13. Multi-user detection method according to one of Claims 10 to 12, characterised in that, for each transmission channel (k), the results of formation of channels are weighted ($540_{1,k}$,..,$540_{P,k}$) by complex coefficients and then summed, the said coefficients being obtained from the estimated propagation characteristics ($\hat{\alpha}_{p,k}$,$\hat{v}_{p,k}$) of the different paths (p) of the transmission channel (k).

14. Multi-user detection method according to one of the preceding claims, characterised in that, for each user k, the directions of arrival and the propagation characteristics of the different paths are estimated from the a priori knowledge of a symbol transmitted by the said user.

15. Multi-user detection method according to Claim 2 or 4 to 14 dependent on 2, characterised in that it comprises the iteration of a set of sequences, each sequence of a user of the second iteration and the following iterations operating on the set of antennae signals where the contributions of the other users have been eliminated at the previous iteration.

16. Multi-user detection method according to Claim 15, characterised in that, at the first iteration, for each user, the directions of arrival and the propagation characteristics of the different paths are estimated from the a prior knowledge of at

least one pilot symbol transmitted by the said user and, at the subsequent iterations, this estimated is effected from at least one data item estimated and remodulated at a previous iteration in addition to the said pilot symbol.

17. Multi-user detection method according to Claims 10 and 15, characterised in that, the propagation characteristics of the different paths being known a priori, the first iteration operates without channel formation, in omni-directional mode, the channel formation being applied as from the second iteration.

18. Multi-user detection device, characterised in that it comprises means adapted to implement the method according to one of the preceding claims.